and stone, brought there by devotees. Behind this, again, is another figure of Buddha, erect, and in the act of giving a blessing. From Muang Fang Mr. Bock went to Tatong, a small Ngiou village on the River Mekok, which is here only 150 feet across. This stream he followed down to its point of junction with the Mekong, which is twice as wide here as the Menam at Bangkok. Ascending the Mekong, Mr. Bock went to Chen Tsen and Chengmai', where again he had difficulties with the natives, who destroyed nearly all his collection of animals, &c. Hence he returned down the valley of the Mekong, and ultimately reached Bangkok on June 14.

THE COMET

MERIDIAN observations of the comet which was first detected in this country by Mr. Ainslie Common, at Ealing, at 10.45 a.m. on September 17, were made at the Observatory of Coimbra on the 18th, 19th, and 20th, and the following first approximation to the orbit has been deduced from them by Dr. Hind :—

Perihelion passage September 17·1047, M.T. at Greenwich.

Longitude of perihelion	... ...	° ′ 271 39·5
,, ascending node	... ...	347 44·6
Inclination	... ...	37 9·6
Logarithm of perihelion distance	... ...	8·09201

Motion—retrograde.

These elements bear a striking resemblance to those of the great comet of 1843 and 1880, and it hardly admits of a doubt that we have here a return of that body, which will have experienced an amount of diminution of velocity at the perihelion passage on January 27, 1880, sufficient to cause the last revolution to occupy only two years and eight months, and which if experienced to the same extent on the 17th of last month, may bring the comet round again in October 1883.

The comet was perceived in the forenoon of September 18, at many places in the South of France, Spain, Portugal, Italy, &c. From Nice we read :—"Toute la ville a admiré aujourd'hui (September 18), pendant cinq heures, un astre nébuleux brillant vers 3° à l'ouest du soleil." It was seen a day earlier at Reus. M. Jaime Pedro y Ferrier reports : "Le dimanche, 17, à 10h. du matin, les habitans s'arrêtaient avec étonnement sur les places pour admirer la comète visible près du soleil vers 1°·5 à l'ouest. Elle était si brillante qu'on l'apercevait à travers de légers nuages. En l'examinant à l'aide d'une jumelle munie d'un verre noir, on distinguait la queue qui s'allongeait en s'élargissant." The comet was observed at 11 a.m. on September 22, by Prof. Riccò, with the refractor of the Observatory at Palermo : its approximate position at noon was in R.A. 11h. 5m. 39s., and Decl. −1° 51′, according to a communication in the *Giornale di Sicilia* of the 24th, from Prof. Cacciatore, director of the Observatory ; it was not then visible without a telescope, but on the following morning, shortly before sunrise, it was visible to the naked eye, exhibiting a very distinct nucleus, and a tail about 6° in length, leaning towards the south.

A circular from Prof. Krueger, editor of the *Astronomische Nachrichten*, states that the comet was observed at Vienna on September 28, at 17h. 15m. Vienna mean time, in right ascension 161° 28′, and declination −5° 51′. Prof. Auwers observed it at St. Vincent, on his voyage from Hamburg to Punta Arenas, to take part in the observation of the coming transit of Venus. Signor Luciano Toschi found it very distinct to the naked eye at Imola, in Italy, on the morning of the 25th, the apparent length of the tail being equal to the distance between Sirius and κ Orionis, which assigns it an extent of more than 15°.

The Coimbra meridian observations, to which reference has been made, furnish the following places :—

Greenwich M.T.		Right Ascension. h. m. s		Declination. ° ′ ″
Sept. 18·01062	...	11 30 58	...	+1 22 24
19·00166	...	11 21 59	...	+0 24 38
19·99437	..	11 15 24	...	−0 25 32

It appears probable that between the time of Mr. Common's observation on the 17th, some hours before the perihelion passage and the meridian observations at Dun Echt and Coimbra on the following day, material perturbation of the elements defining the position of the plane of the orbit may have taken place ; at any rate, the above orbit deviates considerably from the Ealing observations. Assuming that the comet is identical with that discovered by M. Cruls at Rio de Janeiro on the morning of September 12, and that he has obtained a good series of observations of position on the following days, it will be interesting to compare the elements deduced from them with those calculated upon observations made subsequent to the perihelion passage.

From a circular which we have received from the Observatory of Palermo, it appears that Prof. Cacciatore utilised the appearance of the comet in an unwonted manner ; we read : "Mentre l'Italia tutta commuovesi per la grande sciagura toccata ai nostri fratelli delle provincie venete e lombarde, ed in ogni regione constituisconsi con nobile e patriottico slancio comitati di soccorso per venire in aiuto a tanti mali, a secondare il pietoso intento, l'Osservatorio aprirà la sue sale all' alba del 26 alle ore 5 precise, a quei genorosi visitatori, che versando una contribuzione di L. 200 vorran godere del sorprendente spettacolo osservandolo al grande e magnifico nostro Refrattore. Siam certi che la sperimentata filantropia della classe agiata di Palermo non renderà vano l'appello dell' Osservatorio. Per tal guisa l'apparizione di questa cometa, che in altri tempi sarebbe stata segnata come foriera dell' ira divina, e causa delle attuali miserie verrà invece registrata come apparizione benefica alla umanità."

[Since the above was in type, we learn by a communication from Mr. David Gill, dated Royal Observatory, Cape of Good Hope, September 11, that the comet was remarked by Mr. Finlay, the First Assistant, at 5h. a.m. on September 8, or four days before it was found by M. Cruls, at Rio de Janeiro. An exact determination of position on the following morning gave—

	Cape M.T. h. m. s.		R.A. ° ′ ″		Decl. ′ ″ ″
Sept. 8, at	17 13 58	...	144 59 51·4	...	−0 45 30·0

Observations were made on the morning of discovery, but the comparison star was not identified with certainty.

Prof. Riccò reports marked changes in the spectrum of the comet from day to day, from Palermo observations.

In the *New York Daily Tribune* of September 21, the identity of this comet with that of 1843 and 1880 is pointed out by Prof. Lewis Boss.]

SPECTROSCOPIC WEATHER DISCUSSIONS

TO readers of NATURE who have attended years ago to Mr. Norman Lockyer's most accurate quantitative determinations, by spark spectroscopy, of the relative proportions of silver and gold in certain alloys ; and to Prof. Hartley's similar quantitative analyses more recently by photographed spectra of the strength of different solutions of metallic salts—there need be no difficulty in allowing, that if a meteorological spectroscope can ordinarily show the standard fact of watery vapour being in the atmosphere, it may also, by a little extra nicety and tact in its use, be able to quantify to some extent the proportions of such aërial supply of water-gas at different times, and so to become, in conjunction with the natural

philosophy of rainfall, a "rain-band," or rain-predicting spectroscope.

There are some persons who will persist in opening the slits of their spectroscopes too wide, and obtaining thereby, when they look at the light of the sky, only a brilliant continuous spectrum of showy colours, or who let the sun, or some strong light glance across the slit, and can then see nothing satisfactorily. But all those others who narrow down the slit almost to extinction, and focus the eyepiece nicely to their own eye, looking from a shaded corner out to a portion of the low, day illumined sky in front of them—all who in fact just do the simply right and proper thing to begin with, have no trouble in seeing, as they extend across the spectrum strip of the daylight, besides the thin solar Fraunhofer lines, and certain hazy lines and bands parallel thereto, and depending on the absorption of the dry gases of our atmosphere—they all, I say, agree and acknowledge that they can also see one, two, or three other bands, which from their places amongst the colours and solar lines, are known to be the spectroscopic imagings of watery vapour. Hence among the recent discussions in the *Times*, the *Scotsman*, and other daily or weekly papers, there was practically no disputation that the spectroscope has the faculty of showing the presence of the otherwise quite invisible watery vapour in the atmosphere. But some of the writers contended that it showed the fact either so faintly, or so capriciously, that the method was of little use even as a hygrometer; could only give deceptive disheartening results in predicting the probable occurrence of rain, and must be looked on merely as one of a number, and by no means the best, of "weather prognostics." Is it worth while, therefore, to pursue the method further?

If with the hope of overcoming the already formed idiosyncratic prejudice of some one human mind, it is not worth while. For there is nothing so easy for an unwilling observer, as to ignore the nicety, and overlook the precision of any quantitative spectroscopic observation; especially when this mode of employing the instrument in our present inquiry has been loudly condemned in public under a depreciating name, which would bring it into the same category as the herd-boy's confident advice to Dean Swift: "Sir, when you see that bull turn his tail to the hedge, then you may be sure it is going to rain."

But we need not after all be offended at the mere name of "prognostic;" for are there not prognostics *and* prognostics in meteorology! What are not the risings and fallings of the wind-compelling barometer itself, but a weather prognostic for those who can interpret them. And even a chart of isobars collected instantaneously from the whole extent of Europe by telegraph, and mapped down in a central office in London, is only another weather prognostic—of a very grand and expensive kind truly; but neither perfect in its forecastings for every part of the country, nor so generally available as could be desired to each private individual therein. I myself, though charged with the meteorological reductions for all Scotland, have never been favoured with a single telegraphic communication of fore-casted weather from the London Office since its establishment. And if I wait, as I did recently, for the isobar map in the *Times*, it arrives here twenty-four hours late of the meteorological events it records; an interval quite long enough to allow of an unwarned-for cyclone having meanwhile entered the country on one side, and left it on the other, after a devastating course across it.

Wherefore a very good apology may surely be set up for many, very many persons in the provinces continuing to observe and speculate on the weather for themselves at their own places of abode, supplementary to any forecasts that may be issued once a day from London. And if such worthy persons do propose to take up the study of the atmospheric water-vapour, or rain-band spectroscope, I do beseech them not to trust to it alone; but endeavour to observe simultaneously with it barometer, thermometer, and wet-bulb hygrometer, not forgetting both wind and cloud. But in that case do you ask, "can the spectroscope give such an observer anything he has not yet already?" It can; for it gives him an instrument far more portable than any other, seeing he can carry it (in its most usual form) literally in his waistcoat pocket; can use it at a moment's notice, when in motion as well as at rest; besides which it gives him such a feeling of certainty and security to know, that even from ever so confined a crib or cabin, with no more than a few cubic feet of peculiar, and for science-purposes vitiated, air about it—he is nobly looking through the whole atmosphere from the surface of the earth right through to space outside, and analysing its condition as to watery vapour (the raw material of rain, as the *Times* happily phrased it) in one instantaneous, integrating glance.

On the other hand, no doubt there is the drawback that no meteorological spectroscope can be used at night, nor in a London fog. It is a daylight instrument, and requires the best part of the daylight too. But such natural light usually lasts long enough to enable anyone to make fifty observations a day, and more too if he be so inclined; though *one* will be usually quite enough in all ordinary weather, if the observer attend to such necessary precautions as these, viz.:—

Observe always low down near the horizon, for atmospheric effects in the spectroscope are there nearly twenty times as strong as in the zenith. Get an opening between clouds if you can to observe through. Prefer that the sun itself shall be angularly distant from your observing direction; and behind a cloud also, if possible, at the instant, so as not to illumine the motes in the air of your neighbourhood with its high altitude light. Especially avoid the minutes of sun-rising or setting, for that act, or rather position, brings certain of the dry gas bands into a short-lived maximum of intensity, without any other signification than that the sun *is* then on the horizon. But good observations may often be taken through falling rain, though not through falling snow, and also between the earth and the under sides of the clouds, if they entirely shut out all view of the air of the heavens beyond them.

Sometimes dense coal smoke, or thick low fogs and mist may prevent the observer obtaining his usual spectroscopic shot at a very low angle of altitude; and if he then points the instrument higher, the telluric rain-band is necessarily weaker. How then is he to eliminate that mere accidental, though most forcible, effect? Simply by making his notation of the strength of the rain-band not absolute or solitary, but differential in terms of another band which is not connected with watery vapour. And herein he will find himself much assisted by the arrangements of nature, or thus:—

The strongest of the water vapour or rain bands in the spectroscope is on the red side of the solar D line, and apparently attached to it; while at a very little distance, removed away on the yellow side occurs a dry gas band, called at home, in a lady's journal, the "low-sun band." But throughout the greater part of the day forming only a faint, constant shade, in terms of which the rain-band may be entered; and as they are both affected in the same degree by merely being looked at in a high or low sky, the proportion between the two, which is all that we require for the intended quantification of watery vapour, remains the same.

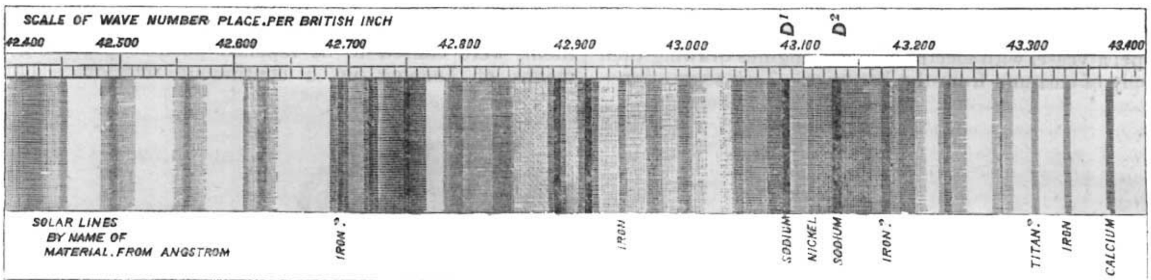
Again, before deciding on what conclusion, as touching rainfall, is to be drawn from any particular degree of darkness of the said water-vapour band, let the observer consider the temperature of the air at the time. Run down the columns of Mr. Glaisher's invaluable tables for reducing hygrometric observations, and obtain thereby a

vivid idea of how rapidly the power of the air to hold moisture in invisible suspension increases with the temperature; and remember that it is not until the quantity of watery vapour accumulates to a still greater extent than what air of such temperature can assimilate, that there is spare material enough for producing rainfall. Hence, while in Scotland a rain-band of intensity marked 2 usually produces a little rain, and 3 produces much, yet in Lisbon during the same months the so-called rain-band, but really only water-vapour band, may mark 4, and yet no rain fall. But with 5 or 6, the temperature remaining the same, down rain will come even in that usually arid country.

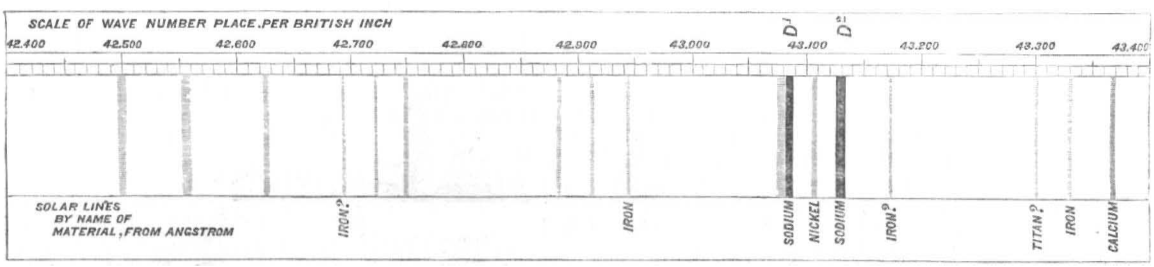
Again, whatever number of supernumerary observations any person may take, when his enthusiasm-fit is upon him, he should never neglect his usual, regular observation at a fixed hour, say 9 a.m. For if the wet-bulb depression goes through a diurnal rise and fall according to the hour, something of the same kind may be looked for in the strength of the spectral water-vapour band; though fortunately it is not so very marked a feature there, because the upper strata of the atmosphere are more constant in their composition from hour to hour, than its lower beds in contact with earth and water.

But why should I go on wearying readers of NATURE with these little details, when they can far better find out such things for themselves, and often realise improvements therein. See how well Mr. Rand Capron has mastered the subject, in his "Plea for the Rain-band" in Mr. Symon's Meteorological Magazine. How acutely Colonel Donnelly appears to have detected in the second water-vapour band of the spectrum, viz. that near the solar C line (a darker part of the spectrum than that occupied by the band near D, and therefore more difficult to observe), an indicator of a different order of precipitation from the atmosphere than ordinary rainfall. And again I trust to be excused for mentioning here that my friend, Mr. T. Glazebrook Rylands, has now accumulated an immense deal of experience as to the advantage of supplementing spectroscopic rain-band observations with a polariscope equally portable.

At present, when experimenting for further advance, I



The Water-Vapour band on the Red side of D^1 and D^2; as seen in the faintly illuminated North-Western sky at 5° above the horizon, from Royal Terrace, Edinburgh, through the average of August 1882, at 10 a.m. each morning, with a powerful spectroscope. Temp. = 62°·0, depression of wet bulb = 3°·0.



The same as seen on September 4, 1882, on the eve of a whole week of very dry weather; temp. = 55°·0, depression of wet bulb = 5°·2.

rather prefer the spectroscope alone, but of greatly increased size and power; and it was not until very lately that I fully experienced what can be done in this way upon merely the faint light of the sky near the northern horizon, a region seldom seen here without more or less clouds and much manufacturer's coal-smoke, yet forming a better constant of daylight than if I had attempted to look southward into the neighbourhood of the sun.

On direct sunlight, whenever it can so very rarely in this country be enjoyed, of course almost any spectroscope will show multitudes of lines, and even split up telluric bands into many fine lines; but to see a large spectroscope accomplish nearly the same fact on merely low sky illumination, gave me a new idea of the discriminating powers of this marvellous modern apparatus, and impressed me with the positive duty of trying to use it quantitatively, as well as qualitatively. I append, therefore, a map of the lines and bands of the chief "rain-band," so called, of the ordinary spectroscope, but now as seen in the larger instrument through the average of last August; and again, for a contrast, as it was seen on one particular day, September 4, when a week of the driest and coldest weather of the season was about to begin.

The hygrometer readings taken elsewhere conformed pretty well to these descriptions; but in their whole variations from 2° or 3° for the earlier, and 6° for the latter time, there was nothing to call up such intense interest as the spectroscope's astounding fact of the almost entire sweeping away on September 4 of the many and rich details of the previous month, in so far, of course, as they were water-vapour spectral details. Nature herself does therefore offer in the way of groundwork for rainfall forecasting in the spectroscope, so large an amount of material, that I do trust no one will undervalue it, until they have had practice, with an equally powerful instrument with that I have just alluded to. Its main features are, that the object-glasses of both collimator and telescope are 2·25 inches in diameter; each of its two prisms is 7 inches long and 3·5 inches square at the end, and contains bisulphide of carbon at a refracting

angle of 104°, while the telescope's magnifying power is 15°. The definition of the prisms had been previously tested on bright hydrogen lines in a dark field, and found to be admirably perfect, much to the credit of their maker, Mr. Adam Hilger.

Take it all in all, nothing less powerful should be employed in critical researches; and as these prisms give together a dispersion of 24° between A and H, the pictures they offer, with the further assistance of the telescope, have a physiognomy comparable at once with either Angstrom's or Kirchhoff's standard solar spectrum maps, so universally respected over the whole world.

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Astronomer Royal for Scotland

ELECTRIC NAVIGATION

THE idea of propelling a boat through water by the motive power of electricity is no new one. The invention of the electromagnet showed the power of an electric current to produce a mechanical force. It was no very difficult matter, therefore, for the electricians of fifty years ago to utilise the force of the electromagnet to drive small electromagnetic engines; and from the small beginnings of Dal Negro, Henry, Ritchie, and Page, grew up a group of electric motors which only awaited a cheap production of electric currents to become valuable labour-saving appliances. Nor was it a very long stride to foresee that if a sufficiently powerful battery could be accommodated on board a boat, it might be possible to propel a vessel with electromagnetic engines drawing their supply of currents from the batteries. This suggestion—one of the earliest, indeed, of the many applications of the electromagnet—was made by Prof. Jacobi of St. Petersburg, who, in 1838, constructed an electric boat. Fig. 1, which we here reproduce from Hessler's "Lehrbuch der Technischen Physik," represents the rude electro-magnetic motor or engine, which Jacobi devised for the driving of his boat. Two series of electro-magnets of horse-shoe form were fixed upon substantial wooden frames, and between them, centred upon a shaft which was connected to the paddle-wheels, rotated a third frame, carrying a set of straight electro-magnets. By means of a commutator made of notched copper wheels, which changed the direction of the current at appropriate intervals, the moving electro-magnets were first attracted towards the opposing poles, and then, as they neared them, were caused to be repelled past, so providing a means of keeping up a continuous rotation. This

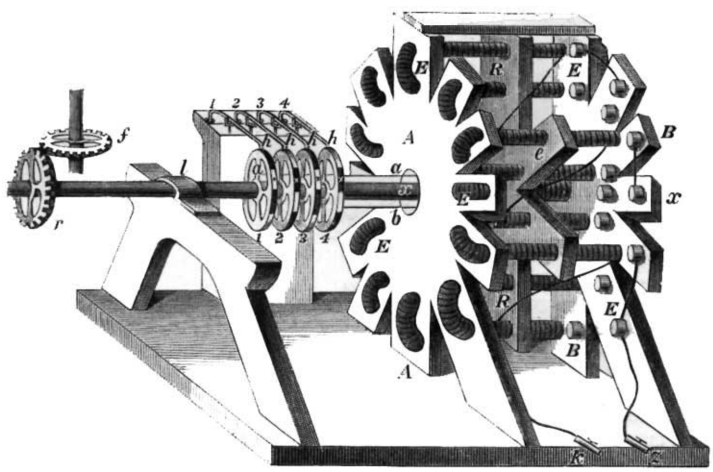

FIG. 1.—The Engine of Jacobi's Electric Boat, 1838.

machine was worked at first by a Daniell's battery of 320 couples, containing plates of zinc and copper, 36 square inches each, and excited by a charge of sulphuric acid and sulphate of copper. The speed attained with this battery did not reach so much as $1\frac{1}{4}$ miles per hour. But in the following year, 1839, the improvement was made of substituting 64 Grove's cells, in each of which the platinum plates were 36 square inches in area. The boat, which was about 28 feet long, $7\frac{1}{2}$ broad, and not quite 3 feet in depth, was propelled, with a convoy of fourteen persons, along the River Neva, at a speed of $2\frac{1}{4}$ (English) miles per hour.

A second attempt at electric navigation was made on a much smaller scale about two years ago by M. G. Trouvé, the well-known manufacturer of electric apparatus, of Paris, who constructed an electric skiff, in which he placed one of his small and compact motors, and drove it by means of a battery of Planté's accumulators, previously charged.

The Neva and the Seine having been respectively the scenes of the first and second efforts at electric navigation, it was fitting that the Thames should be the scene of the third, and most recent one.

The electric launch *Electricity*, which made its trial trip on Thursday, September 28, 1882, on the waters of the Thames, is certainly a great advance upon that which had been previously attained. This boat, the arrangements of which have been designed and carried out by Mr. A. Reckenzaun, C.E., mechanical engineer to the Electrical Power Storage Company of Millwall, is of iron, and is a trifle less in length than the wooden boat which Jacobi propelled. She will carry twelve persons, though at the trial trip but four were on board. The screw-propeller is calculated to run at 350 revolutions per minute, the two Siemens' motors running at 950 revolutions. The accumulators, which weigh $1\frac{1}{4}$ tons, are calculated to supply the necessary current for seven or eight hours of continuous work.

Having been one of a privileged party of four, the first ever propelled upon the waters of the river Thames by the motive power of electricity, I think some details of this latest departure in the applications of electric science may be of interest. At half-past 3 on the afternoon of Sept. 28 I found myself on board the little vessel *Electricity*, lying at her moorings off the wharf of the works of the Electrical Power Storage Company at Millwall. Save for the absence of steam and steam machinery, the little craft would have been appropriately called a steam launch.